Natural Resources

PHYSICAL ENVIRONMENT

Air Quality

Background

The management and enforcement of the Clean Air Act's air quality standards in the Death Valley National Park area is conducted by two entities, the Mojave Desert Air Quality Management District and the Great Basin Unified Air Pollution Control District. The Mojave Desert Air Quality Management District includes the desert portion of San Bernardino County (within the South East Desert Air Basin) and the Great Basin Unified Air Pollution Control District includes Inyo and Mono Counties (within the Great Basin Valley Air Basin).

Congress established the Prevention of Significant Deterioration program as part of the Clean Air Act. To facilitate the implementation of this program, an area classification scheme was established. This classification scheme has class I receiving the highest degree of protection with only small amounts of certain kinds of additional air pollution (sulfur dioxide and particulate matter) allowed. The other two areas are class II, which allows moderate increases in certain air pollutants; and class III, which allows a large amount of new air pollution (Congress has yet to designate any class III areas). There are no class I areas in the California Mojave Desert. Death Valley National Park is a class II "floor" area, meaning that it may never be redesignated to class III.

The Clean Air Act developed national ambient air quality standards for a finite number of criteria pollutants. The criteria pollutants are: sulfur dioxide, carbon monoxide, total suspended particulates, nitrogen oxides, lead, ozone, and particulate matter less than 10 microns in diameter (PM_{10}).

Nonattainment areas are areas that are not in compliance with the national ambient air quality standards, and therefore must reduce pollution to reach compliance. The San Bernardino County portion of Death Valley National Park is in nonattainment for California's state ozone standards.

Federal PM_{10} nonattainment areas include the San Bernardino County desert area, Owens Valley, Mammoth Lakes, Mono Basin, and the Searles Valley planning area. Mono and the eastern portion of Inyo counties have not recorded PM_{10} emissions in excess of the national standards.

One nearby source of pollution is the Searles Valley (Trona) complex that produces soda ash, borax, potash, and other chemicals from Searles Dry Lake. Other nearby sources of emissions include Owens Lake, Owens Lake Soda Ash Company, U.S. Army's National Training Center at Fort Irwin, China Lake Naval Air Weapons Station, Briggs Mine, and Panamint Valley Limestone Quarry. Air quality monitoring activities occur at Death Valley National Park and at the Briggs Mine. The Briggs Mine has two real time PM_{10} monitors that collect data continuously. This data is reported to the Great Basin Unified Air Pollution Control District on a quarterly basis. This system is set up to allow the district to access the real time data via a modem.

Exposed lakebeds and farmlands lie in the Owens Valley and Mono Basin between mountain ranges. Wind-carried dust from these exposed lands in the valley adversely affect air quality over the area (U.S. Forest Service, 1988). Visibility has been affected to the extent that Department of Defense test flights over the Owens Valley are hampered or shut down 6 to 12 times each year (U.S. Forest Service, 1988). The county, the Great Basin Unified Air Pollution Control District, the city of Los Angeles, the Department of Defense, and the Inyo National Forest are making coordinated efforts to resolve this concern.

Local pollution sources in the desert consist primarily of particulate matter from offroad vehicles, windblown soil, mining operations, livestock grazing, and agricultural activities. These sources have left certain areas denuded or sparsely vegetated, allowing wind erosion to occur and air quality to suffer, occasionally causing particulate standards violations at some locations.

Death Valley National Park currently has an air quality monitoring program which monitors ozone (including meteorology) and particulates. Both are managed under the NPS national program contracts. The Park will soon be adding wet and dry acid deposition monitoring. All air quality monitoring occurs at a monitoring station at Cow Creek, 5 miles north of Furnace Creek.

The National Park Service is responsible for protecting air quality under both the 1916 Organic Act and the Clean Air Act. Although the Clean Air Act gives the highest level of air quality protection to class I areas, it provides many opportunities for the National Park Service to participate in the development of pollution control programs to preserve, protect, and enhance the air quality of all units of the national park system, including class II areas. The National Park Service will seek class I designation for the Park.

Sections 118 and 176 of the Clean Air Act require federal agencies/facilities to meet all federal, state, and local air pollution control laws and regulations. In the case of units/facilities located in areas not meeting federal or state air pollution control standards (nonattainment areas), the units/facilities must conform to requirements established to attain and maintain those standards. The requirements could include provisions to reduce emissions from existing facilities and limit emissions from proposed facilities on a greater than 1:1 basis.

A more efficient and comprehensive approach for reducing regional haze that veils scenic vistas in parks was announced in April 1999 in a final rule. This rule builds upon existing air pollution control programs which are designed primarily to protect public health, and the first plans are due at the same time states submit plans for meeting new health-based air quality standards adopted by the Environmental Protection Agency (2005–2008). But, the rule requires steady and continuing emission reductions even after health goals are met and sets a target date of 2064 for achieving "natural" visibility conditions in national parks and wilderness areas. States will be required to submit 10-year plans, with measures needed to stay on track toward that target (at least a 10% improvement in visibility each decade). Irrespective of what other measures states may choose to adopt, the rule requires that the "best available retrofit technology" (BART) be installed at hundreds of power plants and industrial facilities that were built without pollution controls and have otherwise avoided installing modern technology. States will have the option of achieving BART-or-better emission reductions through economic incentives or market-based programs.

Plan Actions

The National Park Service will seek to perpetuate the best possible air quality in the Park because of its critical importance to visitor enjoyment, human health, scenic vistas, and the preservation of natural systems and cultural resources. The National Park Service will work to promote and pursue measures to safeguard these values from the adverse impacts from air pollution. The National Park Service will strive to set the best example for others to follow in their development and management activities. When the impacts of existing or potential air pollution on Park resources are unclear, the National Park Service will err on the side of protecting air quality and related values for future generations. The Park's air monitoring program will continue. Death Valley National Park has a National Oceanographic & Atmospheric Administration weather station at Furnace Creek and will continue to be a participating member of a national air quality network and will monitor ozone and particulate matter.

Since the Park is located in a nonattainment area for one or more air pollutants, no actions taken will lead to violations of federal or state air pollution control laws or regulations nor will they increase emissions that will violate the state conformity requirements. Park staff will work with air pollution control officials to ensure compliance with those requirements.

Viewsheds

Background

Visibility is probably the most important air quality resource in the desert region, and it is the most easily affected by activities that generate dust (especially fine particulates) and sulfur dioxide. Visibility impacts occur from long-range transport of pollutants from as far away as the San Joaquin Valley and the Los Angeles basin (RESOLVE study 1988, cited in BLM 1995).

Local pollution sources in the desert consist primarily of particulate matter from off-road vehicles, windblown soil, mining operations, livestock grazing, and agricultural activities. These sources have left certain areas denuded or sparsely vegetated, allowing wind erosion to occur and air quality to suffer and occasionally causing violations of particulate standards at many locations.

Plan Actions

The Park will prepare guidelines for the developed areas. These guidelines will be prepared to establish visual consistency and themes in facility development. Guidelines will also be created for reaching visual compatibility with surrounding landscapes, significant architectural features, and site details. The primary objective of guidelines will be to create harmony between the built environment and the natural environment.

With the increasing use of cellular communication equipment, more antennas and relay equipment are being installed throughout the country. The overall management goal of each NPS unit will be to protect and maintain the visual quality of the landscape and the built environment. The Park will implement the following objectives for communications equipment proposals:

- All above-ground communication equipment should not significantly distract from the visual quality of the scenery.
- Each new proposal for radio or cellular antennas or towers must demonstrate that the equipment will provide a critical service for visitors and NPS staff and is not duplicative.
- The installation of new equipment outside the Park or on existing communication towers or at defined sites should be considered before the construction of new sites in Park is considered.
- New locations will be reviewed through the environmental assessment process, which must consider impacts on the visual quality of the scenery.

The National Park Service will work with neighboring landowners on topics of mutual interest being sensitive to the influences and effects that Park management might have on adjacent landowners. The National Park Service will seek to enhance beneficial effects and to mitigate adverse effects in ways consistent with its policies and management objectives. The agency will encourage compatible adjacent land uses and seek to mitigate potential adverse effects on Park values by actively participating in planning and regulatory processes of neighboring jurisdictions, other federal, state, and local agencies, and Native Americans.

Night Sky

Background

Within Death Valley National Park, the night sky toward the southeast is noticeably impacted by lights from Las Vegas, perhaps with some Pahrump, Nevada influence. This is especially apparent while heading south from Grapevine and Stovepipe toward Cow Creek and Furnace Creek. Other light sources are essentially limited to the Furnace Creek and Stovepipe Wells areas of Death Valley National Park, residential lighting from small communities such as Shoshone and Death Valley Junction, vehicles, and minor stationary lighting. Nighttime activities at Briggs Mine and Panamint Valley limestone quarry may be observed from Panamint Valley and portions of Death Valley National Park overlooking Panamint Valley. The Bureau of Land Management has required an approved lighting plan that seeks to minimize night sky pollution from the mine.

Plan Actions

The National Park Service will cooperate with neighbors and local government agencies to seek to minimize artificial light intrusion, recognizing that darkness and the night sky are part of the overall visitor experience. The National Park Service will strive to set the best example in all developments that involve the use of artificial outdoor lighting, ensuring that it is limited to basic safety requirements and is shielded to the maximum extent possible, to keep light on the intended subject and out of the night sky. Baseline light measurements will be established for night use for monitoring changes over time.

Noise and Overflights

Background

A high level of traffic is observed along State Highway 127 between Baker, California and Death Valley Junction (Caltrans 1996). Vehicle noise is generally not an issue in the Park in spite of the many and heavily used roads including State Highways 127, 190, and 178, and NPS major paved roads. Because of the Park's size, most areas are well away from traffic and its noise.

Other areas where localized noise occurs are at the BLM-managed Dumont Dunes off-highway vehicle open area and at mining operations. Less localized is noise from military overflights. Frequent low-level military overflights are often seen in the Panamint and Saline Valleys. If the National Training Center's (Fort Irwin) expansion is approved, sporadic and significant localized noise would be generated in the southern boundary of Death Valley National Park (BLM 1996).

The Park is in the vicinity of several U.S. Department of Defense facilities: Fort Irwin Military Reservation, China Lake Naval Air Weapons Station, Edwards Air Force Base, and Nellis Air Force Base. Military aircraft from these facilities often use airspace in the Park. Although aircraft noise does not appear to affect wildlife, visitors to the area often react adversely to jet noise and sonic booms. In addition, some booms have caused damage to natural and cultural resources (NPS 1988).

Military overflights constitute the primary source of high-level noise incidents in the Park. Parts of the Park are within a joint service R-2508 special use airspace complex designated as a military operations area (MOA) (Saline, Panamint, and Shoshone MOAs) that permits aircraft to fly at speeds exceeding 250 knots and at altitudes 200 feet above ground level or higher (DOD 1995). The military operations area is used on a daily basis by Navy and Air Force aircraft. Low-level overflights of various military aircraft are common in the vicinity of the Park.

In 1976, the Joint Policy and Planning Board Commanders (NAVAIRWPNSTA China Lake, Edwards Air Force Base, Fort Irwin, and George Air Force Base) agreed to restrict overflights above the existing national monument boundaries to 3,000 feet above ground level within the R-2508 Complex. The successive creation of the Complex Memorandums of Agreement in 1977 excluded this airspace; however, the exclusion was not extended to the expanded areas under the designated areas below the 3,000-foot restriction. A process is in place for all complaints and reports of overflight restriction violations, forwarded by the National Park Service or the public, to be investigated and handled by the Complex management.

Title VIII of the California Desert Protection Act, 1994, provides that:

> Nothing in this Act, the Wilderness Act, or other land management laws generally applicable to the new units of the National Park or Wilderness Preservation Systems (or any additions to existing units) designated by this Act, shall restrict or preclude low-level overflights of military aircraft over such units, including military overflights that can be seen or heard within such units.

Plan Actions

The National Park Service will strive to preserve the natural quiet and sounds associated with the physical and biological resources of the Park. Activities causing excessive or unnecessary sounds in or adjacent to the Park, including low-level aircraft overflights, will be monitored, and action will be taken to prevent or minimize unnatural sounds adversely affecting Park resources and values or visitor enjoyment. The National Park Service will collaborate with the Department of Defense to minimize impacts on visitors and resources from military overflights, as authorized by sec. 802 of the California Desert Protection Act.

Water Resources

Background

Groundwater. Groundwater is found throughout the Park and varies greatly in depth and quality. The Park's groundwater basins are recharged from surface and subsurface infiltration. Depletion of groundwater basins and a diminishing of water quality are some of the concerns that were expressed at public meetings. Groundwater is the Park's principal source for desert springs, seeps, and streams. The maintenance of groundwater quality and quantity is critical to the survival of desert surface waters and their associated plant and animal life.

The major concern is that Park water and water-related resources will be affected by up-gradient withdrawals and contamination. Death Valley National Park receives much of its water from the lower portion of the Death Valley groundwater flow system's flow from Nevada (Pal 1995). The Death Valley groundwater flow system is defined in general terms as the area where groundwater flow is toward Death Valley. Some groundwater inflow also occurs from areas in California that are adjacent to the Park. The Death Valley groundwater flow system is believed, by the National Park Service, to be fully, if not over, appropriated. Existing and future appropriations of limited water resources from the flow system may result in impacts to Park water resources. Additionally, potentially contaminated groundwater plumes from the Nevada Test Site or from cyanide runoff from the large mining operation near Bullfrog could contaminate the regional aquifer that drains into the Park (NPS 1988). The Bullfrog Mine is and will continue to conduct groundwater testing until 2005. That company reported that no ground water contamination has been detected (Barrick/Bullfrog Mine, January 14, 1999 letter to NPS regarding the DEIS).

Water Use

Another site where extensive groundwater is being used at rates that exceed normal groundwater recharge is the Briggs Mine adjacent to the Park. The Briggs Mine has an approved mining plan that calls for the groundwater withdrawal of about 640 acre-feet per year (BLM, 1995a). This increase in groundwater withdrawal is in addition to the existing groundwater withdrawal of 750 acre-feet per year from the Panamint Valley (BLM 1995a).

Surface Water. Known surface water sources in the Death Valley region include seeps, wells, springs, and ponds. The small springs and seeps in the Park offer isolated and limited water for plants, wildlife, domestic, or commercial purposes. Some springs produce potable water, but overall, water quality is poor because of high dissolved mineral concentrations (BLM 1996).

In 1972, some 330 water sources of varying dependability and quality were recorded within the monument's boundaries (FWS 1972). The majority of these water sources were found in the Cottonwood, Panamint, and Grapevine mountains. Discharges from these sources range from a minimal

seep to rates exceeding 200 gallons per minute. Death Valley's enlargement to a National Park in 1994 added an additional 1.3 million acres. These new lands include additional water sources such as Darwin Creek, Saline Warm Spring, and many springs in the Nelson Range and Whippoorwill Flat areas of the Inyo Mountains.

Death Valley's perennial streams include Salt Creek, Furnace Creek, Cottonwood Creek, and Darwin Creek. The Amargosa River is also perennial, but only for short stretches, with its length varying seasonally. Other streams flow seasonally from springs in some of the larger canyons on the west side of Death Valley, such as in Hanaupah and Johnson canyons (NPS 1988).

Perennial ponds are rare within the Park, and they fluctuate in size with the season. The largest ones (more than 6 acres) are immediately north of Saratoga Springs. Several artificial ponds and ditches supplied by the Travertine Springs are maintained by AMFAC, Inc., on its Furnace Creek properties (NPS 1988).

Cattle ranching, mining, and resort development in the desert required changes in the natural water flow, quality, and supply. Flows from springs and seeps were diverted or dammed, water was piped miles away from the source, wells were drilled, stock tanks were excavated, and other developments were needed such as wind mills and troughs. These changes brought with them changes to the natural environment. When the flows from the springs and seeps were diverted, the remaining aquatic/riparian flora and fauna were greatly reduced or eliminated. The water piped from the springs and seeps or taken from wells and piped to tanks and troughs is used by cattle, burros, and wildlife.

Water Rights. Initial research on outstanding water rights in the Park at the State Water Resources Control Board in Sacramento revealed that there are approximately 45 appropriated water rights claims on 41 water sources (springs, seeps, streams, wells) in the Park.

The California Desert Protection Act of 1994 in section 706(a), with respect to each wilderness area, reserves a quantity of water sufficient to fulfill the purposes of the act. Section 706(b) mandates that the Secretary of the Interior and all other officers of the United States take "all steps necessary to protect the rights reserved by this section." Federal reserved rights generally arise from the purposes for the reservation of land by the federal government. When the government reserves land for a particular purpose, it also reserves, explicitly or by implication, enough unappropriated water at the time of the reservation as is necessary to accomplish the purposes for which Congress or the President authorized the land to be reserved, without regard to the limitations of state law. The vested rights are valid as of the date of the reservation, whether or not the water is actually put to use, and are superior to the rights of those who commence the use of water after the reservation date. General adjudications are the means by which the federal government claims its reserved water rights. The McCarran Amendment (66 Stat. 560, 43 U.S.C. 666, June 10, 1952) provides the mechanism by which the United States, when properly joined, consents to be a defendant in a suit to adjudicate water rights. The precise nature and extent of the National Park Service's water rights probably will remain uncertain until the United States is joined in an adjudication, the Department of Justice files claims to water rights on behalf of the National Park Service, and the court decrees the United States. Hence, it is the responsibility of both the National Park Service and the Bureau of Land Management to protect the reserved water rights established under the California Desert Protection Act and other applicable federal authorities.

Death Valley National Park was involved in a historic water rights decision, when the U. S. Supreme Court in 1976 determined that the NPS had a reserved water right to a certain level of groundwater at Devils Hole. This Supreme Court action is frequently referred to as *Cappaert v. United States*. The purpose of the reserved water right is to maintain the water level in Devils Hole to assure the survival of the Devils Hole pupfish, an endangered species.

Water Developments. A guzzler is a permanent self-filling water catchment. Most are similar to a cistern and are simple, low-maintenance devices that are essentially tanks filled by rain-collecting aprons (Giles 1971). Guzzlers are installed and used to provide water for hunted species in arid areas. Nongame species such as reptiles, songbirds, and insects also use these manufactured devices. Birds enter the covered tank through an opening and walk down a ramp to the water. For bighorn sheep, piping extends from the storage tank to a drinking trough, which has a float valve to regulate the flow.

Death Valley National Park has five big game and two game bird (gallinaceous) guzzlers. The guzzlers

were developed by the California Department of Fish and Game, the Bureau of Land Management, and volunteers prior to the Park's expansion in 1994. A review of guzzler use by Park staff concluded that two of the big game guzzlers received little or no use.

Plan Actions

Water Use. Water will be used efficiently and frugally in the Park. The National Park Service will seek to protect, perpetuate, and possibly restore surface water and groundwater as integral components of Park aquatic and terrestrial ecosystems. Surface water and groundwater withdrawn for the Park's use will be the amount necessary to achieve Park purposes. All water withdrawn from the Park for domestic use will be returned to the Park watershed system once it has been treated to ensure that there will be no impairment of Park resources. Interbasin transfers would be avoided. If adverse effects were found, the National Park Service will take all legal and appropriate steps necessary to protect natural resources from the effects attributed to such activities. The ongoing water-monitoring program will continue. Death Valley National Park will seek to restore, maintain, or enhance the quality of all surface and ground waters within the Park consistent with the Clean Water Act and other applicable federal, state, and local laws and regulations.

The Park will continue to maintain the water levels at Devils Hole, the home of the endangered Devils Hole pupfish. The Park will continue to actively monitor the pool's water elevation. The Park will continue to be involved in an interagency effort to monitor the water flow in the Death Valley Groundwater Flow System to help ensure that any major water extraction that might occur miles away from the Park do not adversely affect the Park's resources. Monitoring other wells and springs within the Park including Darwin Falls and in at least nine water delivery systems will also continue.

Floodplain and Wetland Areas. The occupancy and modification of floodplain and wetland areas will be avoided wherever possible. Where no practicable alternatives exist, mitigating measures will be implemented to minimize potential harm to life, property, and the natural floodplain and wetland values. Management of floodplain and wetland areas is subject to the provisions of Executive Order 11988, "Floodplain Management", Executive Order 11990, "Protection of Wetlands," and the Rivers and Harbors Act, and section 404 of the Clean Water Act.

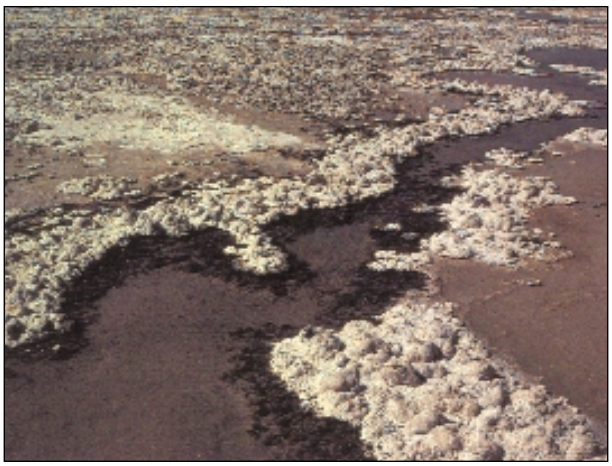
Water Rights. Since 1976 the NPS has been actively protecting the water right to the Devils Hole area. The NPS believes the continuation of this approach is vital to the long term viability and survival of the Devils Hole pupfish and other Park resources.

The NPS participates in California and Nevada administrative water rights proceedings to protect Federal reserved, riparian, and appropriative rights established for Death Valley National Park. The purpose of this participation is to protect Park water rights from injury by threats such as new appropriations for groundwater located upgradient of Park water sources.

NPS *Management Policies* (2001) state:

> *All rights to the use of water diverted to or used on federal lands within the national park system by the United States or its concessioners, lessors, or permittees will be perfected in the name of the United States.*

The National Park Service in its general planning process for each unit of the national park system



and the Bureau of Land Management in its planning process for each wilderness area have jointly agreed to incorporate their respective policies, guidelines, and administrative procedures and apply the following principles to discharge their responsibilities under section 706 of the California Desert Protection Act to manage and protect federal reserved water rights (Desert Managers Group 1995):

- inventory all water sources within the boundaries of the wilderness area/park unit
- share water source inventory data
- jointly request from the California Division of Water Rights notification of any filing for appropriated water rights within or adjacent to the boundaries of BLM wilderness or units of the national park system
- defend federally reserved water rights through the state of California administrative process and, if necessary, seek judicial remedy in the appropriate courts
- quantify the amount of water reserved to fulfill the purpose of the reservation as part of any adjudication in California in which the United States may be joined under the McCarran Amendment
- where necessary, pursue acquisition of any existing nonfederal appropriated water right within their respective jurisdictions
- identify as a federally reserved water right all unappropriated water from any water source identified on federal lands within the boundaries of designated wilderness and/or park areas in the California desert
- because use of percolating groundwater does not require a permit from the state of California, participate in local government proceedings that authorize nonfederal parties to withdraw percolating groundwater where such withdrawals may impact water sources within their respective jurisdictions to which federally reserved water rights are attached
- participate in any proceedings pursuant to Nevada state water law that may authorize withdrawal of groundwater where such withdrawal may impact water sources within their jurisdictions to which federally reserved or appropriated water rights are attached
- vigorously defend water travelling to the Park in the Death Valley aquifer from Nevada
- work with holders of water rights to restore modified water sources to natural conditions while still allowing for valid existing uses

Water Developments. The National Park Service will examine the use of and need for all guzzlers, livestock tanks, and troughs (hereafter referred to as developed water sites). Water at developed water sites will be retained for native plants and wildlife if these facilities were needed to mitigate for local water losses due to previous human activities. Simultaneously, with the retention of these developed water sites, the National Park Service will actively begin to restore natural water sources to be self-sustaining. When a water source became self-sustaining, the artificial facility will be removed. Requests to use motorized access to guzzlers in wilderness areas (to maintain guzzlers or replenish water) will be reviewed individually. If livestock use, including water use, degrades wilderness values, the number of livestock would be reduced to the appropriate level.

Water is necessary for livestock grazing on NPS lands. The amount of water that will be diverted or used for livestock will be maintained for the animals' health. If and when animal unit months (AUMs) were reduced (no increase in AUMs is allowed under the California Desert Protection Act) a concurrent reduction in water for livestock purposes will be expected. The National Park Service will examine these developed water facilities and take action, where appropriate, to restore natural waters. If the National Park Service did not own the water rights, the agency will work with the owners to encourage them to consider the benefits of natural water restoration to restore modified water sources to natural conditions while still allowing for valid existing uses.

Paleontological Resources

Background

Death Valley National Park contains a rich and diverse, but fragile and irreplaceable paleontological record. The fossil record in the Park area is nearly as extensive and complicated as the geological record. Much of the area's geology is exceptionally well exposed. Soil development has been greatly retarded throughout much of the area, and the outstanding exposures of geological features support an equally notable exposure of fossil remains. These organisms have value as (1) stratigraphic indicators for correlation of deposits containing them and for determination of relative geologic age (2) records of past life forms showing the course of evolutionary trends of plants and animals and (3) evidence of changing paleoenvironments.

A literature and records search was completed for the Death Valley National Park region by Earth Sciences curator, Robert E. Reynolds, at San Bernardino County Museum in Redlands. The records and literature search identified a number of potentially sensitive fossiliferous areas within the Park area. Significant paleontological resources and records relating to paleobiostratigraphic events that occur within the Park include:

- The world's oldest mitosing cells, 990 million years old, are preserved in silica in the Beck Spring Formation.
- Significant Cambrian trilobite and invertebrate fossil localities that mark the boundary of the Paleozoic Era, 550 million years of age.
- Significant occurrences of Paleozoic invertebrate fossils and the possibility of very old fossil fish in Death Valley National Park.
- Panamint Range localities that contain significant marine cephalopods and invertebrate fossils.
- The early record of the Oligocene Tertiary Era from north of the Mojave Desert is found in the Grapevine Mountains in Death Valley National Park; important fossils include rodent, canid, horse, helaletid, brontothere, rhinoceros, oredont, and leptomerycids.
- Extremely important Late Miocene trackways, associated with important vertebrate fossils, occur in the Black Mountains in Death Valley National Park and in the Avawatz Mountains south of the Park; the Black Mountains area includes a wide range of camel, horse, gompothere, and aquatic bird trackways associated with a shallow freshwater lakeshore.

Plan Actions

Some paleontological research has been initiated or funded by the National Park Service. Most is accomplished by outside institutions that request and receive NPS research permits. The institutions, in exchange for the opportunity to study NPS resources, agree to provide information that the National Park Service can use to develop strategies for resource protection, management, and interpretation.

Paleontological resources, including both organic and mineralized remains in body or trace form, will be protected and preserved for public enjoyment, interpretation, and scientific research in accordance with Park management objectives and approved resource management plans. Although paleontological research by the academic community will be encouraged and facilitated under research permits subject to NPS management criteria, the National Park Service will enhance its own knowledge of paleontological resources through comprehensive inventory and monitoring programs. To enhance the conservation and management of paleontological resources, the National Park Service will seek to develop collaborative partnerships with government agencies, academic institutions, and public and private organizations with paleontological resource management or research capabilities/expertise. Management actions will be taken to prevent illegal collecting. Actions also might be taken to prevent damage from natural processes such as erosion. Protection could include construction of shelters over specimens for interpretation in situ, stabilization in the field, or collecting, preparing, and placing of specimens in museum collections. The localities and geologic settings of specimens will be adequately documented when specimens were collected.

Geological Resources

Background

Death Valley National Park is, geologically speaking, a part of the larger Basin and Range Province. The Park's oldest rocks were formed about 1.8 billion years ago. The weathered sandstone and limestone rocks from the Funeral and Panamint Mountains are much younger, about 500 million years old, and indicate that this area was the site of a warm, shallow sea throughout most of the Paleozoic Era (570–250 million years ago).

About 3 million years ago, the dynamics of crustal movement changed, and Death Valley proper began to form. At this time, compressional forces were replaced by extensional forces. This "pulling apart" of the earth's crust allowed large blocks of land to slowly slide past one another along faults, forming alternating valleys and mountain ranges. Badwater Basin, the Death Valley salt pan, and the Panamint Mountain Range comprise one block that is rotating eastward as a structural unit. The valley floor has been steadily slipping downward, subsiding along the fault that lies at the base of the Black Mountains. Down-dropping continues today.

Concurrent with the subsidence has been slow but continuous erosion. Water carries rocks, sand, and gravel down from surrounding hills and deposits the pieces on the valley floor. Beneath Badwater lies over 9,000 feet of accumulated sediments and salts.

Recent signs of volcanic activity exist in the northern third of the Park at Ubehebe Crater. Caused by violent steam explosions, the craters formed several

thousand years ago when molten material came in contact with groundwater.

There are five dune areas within the Park. They are located near Saratoga Springs, Stovepipe Wells, Panamint Springs, Saline Valley, and Eureka Valley. "[The Eureka Valley Dunes are] the highest dunes in the Basin and Range Province and possibly in the United States. When observed at sunset from the west, against the backdrop of the Last Chance Range, its nearly vertical west facing slopes resemble a marvelous parfait-like melange of pink, white and numerous other tones of earth colored rocks" (BLM 1982).

Plan Actions

Park geological features will be protected. Certain fragile geological features, such as sand dunes and salt flats will be monitored to determine if measures were needed to prevent or stop human-caused damage. Mapping by U.S. Geological Survey will be conducted to map Death Valley National Park's renowned exposed geology. Resource protection will continue to consist of random patrols of the backcountry as well as limited public closures to protect sensitive sites.

Cave Resources

Background

Caves, as defined by the Federal Cave Resources Protection Act, include any natural feature that a person can enter. They include talus caves, erosional caves, dissolution caves, lava tubes, and others. They do not include mine adits, shafts, or declines. Caves are not common in Death Valley. The most significant cave is Devils Hole.

Plan Actions

NPS *Management Policies* (2001) provide that caves be managed to perpetuate their atmospheric, geological, biological, ecological, and cultural resources in accordance with approved cave management plans. Natural drainage patterns, air flows, and plant and animal communities are to be protected. In general, the NPS management direction is to avoid development of caves and to perpetuate natural conditions, while seeking to protect the resource. Devils Hole is closed to public use to protect the endangered pupfish.

BIOLOGICAL ENVIRONMENT

Background

Death Valley National Park and the adjacent desert support a variety of wildlife species. Within Death Valley and the surrounding desert there are 51 species of native mammals, two species of exotic mammals, over 346 species of birds, 36 species of reptiles, three species of amphibians, and six species of fishes (Hansen 1972 and 1973; Landye 1973). Small mammals are more numerous than large mammals, such as desert bighorn, bobcat, mountain lion and mule deer.

The Nelson bighorn *(Ovis canadensis nelsoni)* is the subspecies native to Death Valley. Bighorn occur in desert mountain ranges where the terrain includes rolling hills for feeding areas and nearby cliffs within steep canyons that can be used for escape. Their range does not correlate with any specific vegetative type. The present population is estimated to be between 500 and 1000 animals. Some researchers believe that the sheep population in the Park is declining in numbers. The cause of this possible decline has not been determined; however, several factors may be involved, including the introduction of diseases from livestock, poor range conditions, rapid increase in human activities (such as mining, road building, urbanization, and increased recreation), illegal hunting, and appropriation of water (Seymour 1972). Competition with other animals and drying of springs are additional factors resulting in loss of habitat. Alternatively, it may be possible that the Park herd is not declining, and the use of different census methods that have varying degrees of accuracy are responsible for "fluctuating" numbers of sheep. To reduce visitor impacts and prevent undue disturbance of wildlife, backcountry camping is not permitted within .25 mile of springs.

The diversity of Death Valley National Park's plant communities result partly from the region's location in the Mojave Desert, a zone of tension and overlap between the Great Basin Desert to the north and the Sonoran Desert to the south (Kearney and Peebles 1960). This location, combined with the great relief found within the Park — from 282 feet below sea level to 11,049 feet above sea level — supports vegetation typical of four biotic life zones: the lower Sonoran, the Canadian, and even the Arctic/Alpine in portions of the Panamint Range (Jepson 1923; Storer and Usinger 1968). Based on Munz and Keck (1968) classifications, seven plant communities can be categorized within these life zones, each characterized by dominant vegetation and representative of three vegetation types: scrub, desert woodland, and coniferous forest. Microhabitats further subdivide some communities into zones, especially on the valley floor.

Scrub or Desert. Scrub is the most extensive vegetation type in Death Valley. It dominates about

three-fourths of the Park landscape and includes the alkali sink, creosote bush scrub, shadscale scrub, and sagebrush scrub communities. The alkali sink or salt flat community occurs in the lower elevations of the Park.

Desert Woodland. Desert woodland is an open, well-spaced community ranging from elevations of about 7,000 feet up to about 9,500 feet. Much of the soil within this community is bare and surfaced with a hard, wind scoured layer similar to desert pavement. The community is dominated by single-leaf pinyon pine (*Pinus monophylla*) and scattered individuals of juniper (*Juniperus osteosperma*).

Coniferous Forest. Coniferous forest in Death Valley National Park includes subalpine forest and some bristlecone pine forests. Both communities occur in narrow belts at upper elevations. Dominants of subalpine forest, including limber pine *(Pinus flexilis),* occur in mosaic concentrations rather than uniformly throughout the area. The bristlecone pine forest community occurs chiefly above 10,000 feet in the Panamint Range, where spacing of individual bristlecones *(Pinus aristata)* and limber pine *(Pinus flexilis)* appear more as an open woodland rather than a forest.

Species and Habitats of Special Consideration

Within Death Valley National Park there are confirmed populations or habitats for 21 state or federally recognized species of concern.

Federally listed species in Death Valley include: desert tortoise (*Gopherus agassizii*), Devils Hole pupfish *(Cyprinodon diabolis)*, southwestern willow flycatcher *(Empidonax trailli extimus)*, least Bell's vireo *(Vireo bellii pusillus)*, Eureka Dunes evening primrose *(Oenothera californica* ssp*. eurekensis)*, Eureka Valley dunegrass *(Swallenia alexandrae),* and spring-loving centaury *(Centaurium namophilum)*.

Federally listed species for which final recovery plans exist are desert tortoise, Devils Hole pupfish, Eureka Dunes evening primrose, and Eureka Valley dunegrass. A draft recovery plan is in development for the least Bell's vireo.

California listed species, other than those also federally listed or proposed, are California (or western) yellow billed cuckoo (*Coccyzus americanus occidentalis*), willow flycatcher (*Empidonax trailli*), Cottonball Marsh pupfish (*Cyprinodon salinus milleri*), and Mohave ground squirrel (*Spermophilus mohavensis*).

California rare plant species, not otherwise federally listed or proposed, are July gold (*Dedeckera eurekensis*) and rock lady (*Maurandya petrophila*).

Desert Tortoise

The range of the desert tortoise includes the Mojave and Sonoran deserts in southern California, Arizona, southern Nevada, the southwestern tip of Utah, and Sonora and northern Sinaloa, Mexico. The Mojave population of the desert tortoise (an administrative designation for animals living north and west of the Colorado River) is listed as a threatened species by the Federal government and the state of California. Critical habitat for this species was designated in 1994 (FWS 1994). There is no desert tortoise designated critical habitat within Death Valley National Park. The desert tortoise's range within Death Valley National Park extends to its southern half. Within the Park the current populations (and for at least the last 60 years) are not believed to be very numerous.

The Mojave population of the desert tortoise occurs primarily in valleys and on bajadas characterized by scattered shrubs. The soils range from sand to sandy-gravel, though caliche soils, desert pavement, and rocky, boulder terrain are occasionally used. Desert tortoises spend a large portion of the year underground to avoid extreme temperatures and, for younger tortoises, to avoid a variety of predators, such as coyotes, foxes, raptors, and ravens (BLM 1996). Tortoises are active during the spring, early summer, and autumn when annual plants are most common and daily temperatures are tolerable. Additional activity occasionally occurs during warm weather in winter months and after summer rainstorms (BLM 1996).

Species Addressed in the Ash Meadows Recovery Plan

Devils Hole is a small tract of land administered by Death Valley National Park while part of a larger spring complex in Nevada called Ash Meadows. Devils Hole falls within the boundaries of Ash Meadows National Wildlife Refuge. A limestone cave at Devils Hole, bearing the same name, is the only natural habitat of the Devils Hole pupfish *(Cyprinodon diabolis)*, listed as endangered by the federal government and state of Nevada. The underground aquifer determines the cave's water level, which has no surface outlet. Historic and

ongoing mining of groundwater in Ash Meadows has occasionally directly lowered the water level in Devils Hole, occasionally exposing a shallow limestone shelf on which the pupfish depend for food and spawning (Soltz and Naiman 1978; E.P. Pister, pers. comm., 1997).

Decline of the Devils Hole pupfish drove litigation resulting in a U.S. Supreme Court ruling upholding the maintenance of a minimum water level at the cave. From 1980 to at least 1990, the population status was upward but "persistently small and localized." The species is considered not delistable; criteria for its protection are the maintenance of water levels and water chemistry. Other species of special consideration located at the limestone cave or at springs within the 40 acres are: Devils Hole warm springs riffle beetle, Amargosa tryonia snail (*Tryonia variegata*), (FWS 1990). Water levels are currently monitored by the National Park Service. The combined records from water level monitoring by the National Park Service and the U.S. Geological Survey dating from the 1960s demonstrated a maximum level of recovery in 1989; thereafter, a downward trend has persisted.

The 1990 U.S. Fish and Wildlife Service Recovery Plan for listed species of Ash Meadows embraced goals of the 1980 recovery plan for the Devils Hole pupfish and addressed the following federally listed species located at Ash Meadows, Nevada, and on National Park Service or BLM-managed areas within adjacent lands in California:

spring-loving centaury (*Centaurium namophilum namophilum*) — FT, NVCE

Ash Meadows sunray (*Enceliopsis nudicaulis* var. *corrugata*) — FT, NVCE

Ash Meadows gumplant (*Grindelia fraxino-pratensis*) — FT, NV Watch List.

Also noted were Ash Meadows endemics.

Essential habitat for the Devils Hole pupfish includes 21,760 acres encompassing the area where groundwater removal most influences the water level in Devils Hole.

Amargosa pupfish and speckled dace, Amargosa niterwort, spring loving centaury, Ash Meadows sunray, Ash Meadows gumplant, alkali mariposa lily, Tecopa bird's beak, and white bear poppy range into California at locations along the Amargosa drainage and at various sites supporting stream, spring, salt marsh, moist alkaline soil, calcareous, or riparian habitats.

Riparian-Dependent Bird Species

southwestern willow flycatcher (*Empidonax trailli extimus*) — FE, sp. level CAE

least Bell's vireo (*Vireo bellii pusillus*) — FE

California/western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) — CAE

Small numbers of all three species have been confirmed along the Amargosa River and in Death Valley.

Federal recovery planning is underway for both the vireo and flycatcher. There is no critical habitat located within Death Valley National Park for either subspecies.

The western yellow-billed cuckoo, state endangered since 1988, generally requires a broader stand of riparian growth than the vireo or flycatcher, although loss of riparian habitat is the major common factor influencing the decline of all.

The cuckoo does not appear to be affected by brood parasitism by the brown-headed cowbird (*Molothrus ater*) which is a severe problem for the vireo and flycatcher. In this behavior, cowbirds introduce their offspring to the nest and care of a host bird species, competing directly with the success of the host's young and sometimes eating or ejecting the host's eggs. (Thelander 1994). If a cowbird problem is identified, Death Valley would work with the U.S. Fish and Wildlife Service to develop a solution to cowbird nest parasitism.

Species Addressed in the Eureka Valley Dunes Recovery Plan

Eureka Valley evening primrose (*Oenothera californica* ssp. *eurekensis*) — FE

Eureka Valley dunegrass (*Swallenia alexandrae*) — FE

shining milk-vetch (*Astragalus lentiginosus* var. *micans*) (*note: has been removed from FPT list)*

Sodaville milk-vetch (*Astragalus lentiginosus sesquimetralis*) — CAE, NVCE, (*note: has been removed from FPT list)*

Prior to the administrative transfer to the National Park Service in 1994, the Bureau of Land Management established the Eureka Valley area of critical environmental concern and in 1982, the U.S. Fish and Wildlife Service adopted the *Eureka Valley Dunes Recovery Plan*. Stemming from these, by draft agreement, a voluntary joint conservation strategy is being developed by the U.S. Fish and Wildlife Service and Death Valley National Park to

protect sites where there are two federally listed and two sensitive plants. The agreement targets actions over entire dune ecosystems to benefit these plants and other species of special consideration including endemic beetles. Two federally endangered species, Eureka Valley evening primrose (*Oenothera californica* ssp. *eurekensis*) and Eureka Valley dunegrass (*Swallenia alexandrae*), and a sensitive species, shining milk-vetch (*Astragalus lentiginosus* var. *micans*), are only found on dunes within Death Valley National Park. Additionally, the California population of another sensitive species, Sodaville milk-vetch (*Astragalus lentiginosus sesquimetralis*), is located at the Park (Diane Steeck, pers. comm., 1997).

The largest population of Eureka Valley dunegrass is found on high, unstable areas of Eureka Dunes, with remaining known stands located in smaller dunes on the west side of Eureka Valley. The major occurrence of Eureka Valley evening-primrose is at Eureka Dunes, but this species is also known from two smaller sites on the west side of Eureka Valley, growing on lower slopes and dune flats. Eureka Dunes and one site on the western Eureka Valley comprise the known range of shining milk-vetch, which grows on mid- and lower-dune slopes and some sandy flats. Sodaville milk-vetch has been found at Death Valley National Park and at two sites in Nevada; it relies on margins of alkaline wetlands, near cool springs (Diane Steeck, pers. comm., 1997).

Notable recolonization of shining milk-vetch has occurred in areas where motorized vehicle use is no longer authorized, but concerns remain with occasional motorcycle and other vehicle trespass, vandalism to barriers and signs and other human uses, including sandboarding/skiing and horseback riding. Possible encroachment and competition with the mid- and lower-dune endemics by the nonnative Russian thistle (Salsola sp.) is another concern. It is believed that the most persistent threat to the Sodaville milk-vetch population at Big Sand Spring has been habitat trampling and modification by burros and cattle (Diane Steeck, pers. comm., 1997). This area has been fenced by the Park to protect the plants.

Other Death Valley National Park Rare Plants

July gold (*Dedeckera eurekensis*) — CA Rare
rock lady (*Maurandya petrophila*) — CA Rare

The July gold (*Dedeckera eurekensis*) and rock lady (*Maurandya petrophila)* grow only in areas containing carbonate soils.

Cottonball Marsh pupfish

The Cottonball Marsh pupfish (*Cyprinodon salinus milleri*), a killifish subspecies, is found only in Death Valley, in "portions of Cottonball Marsh on the west side of the central valley floor approximately 5 miles south of Salt Creek" (*Death Valley National Monument Draft General Management Plan* 1988). The pupfish is a listed California Threatened species. Threats to its survival include direct and indirect habitat alteration from changes to water levels, quality, and/or chemistry. An overall concern with regional water diversion is not limited to this species, rather, it has the potential to affect a large number of sensitive aquatic species (including insects and snails) and riparian obligates.

Mohave ground squirrel

The only known occurrence of the Mohave ground squirrel (*Spermophilus mohavensis*) in Death Valley National Park is at Lee Flat. The ground squirrel is a listed as a California Threatened species. This represents the northernmost extension of the squirrel's range, which is limited to the northwestern Mojave Desert. No records exist of traditional or current presence of the squirrel in Panamint Valley nor Saline Valley (Leitner, pers. comm. 1997).

Although previously found in a variety of vegetation associations to 5,600 feet elevation, the species seems to "prefer large alluvial-filled valleys and deep, fine-to-medium textured soils vegetated with creosote bush scrub, shadscale scrub, or alkali sink scrub wherever desert pavement is absent" (FWS 1995a). Winterfat (*Krascheninnikovia lanata*) and spiny hopsage (*Grayia spinosa*) are important dietary components; the squirrel favors forbs in wet years and winterfat in dry years. The diets of domestic sheep more closely overlap that of the Mohave ground squirrel than do those of cattle or feral burros (Leitner, pers. comm. 1997).

The species' state threatened status is based on habitat loss due to agriculture, recreational, and military vehicle use. In 1995, the U.S. Fish and Wildlife Service (FWS) reviewed a petition to list the species as federally threatened. While the FWS continued monitoring for impacts due to habitat degradation/fragmentation and drought, determined a lack of sufficient information to warrant a status review (FWS 1995b; FWS 1995c). Substantial new information is still lacking about recent trends in squirrel populations, historic occupied range, current habitat, and vulnerability of key populations (Gustafson, pers. comm. 1997).

Other Sensitive Animals

Bighorn sheep are found in most of the Park's mountain ranges. Although there has been no recent surveys, Dr. Douglas who has conducted extensive research on bighorn sheep, believes that the sheep populations are stable (UNLV, pers. comm., 1999). Existing threats to this species include tamarisk invasion of springs and resource competition with feral burros.

The many abandoned mines within the Park provide excellent habitat for many bat species. Any mine reclamation and its potential disturbance would initial include an environmental assessment and implementation of mitigation for the bats.

Riparian habitats are valuable for other species as well. The "Partners in Flight" organization lists 14 birds species dependent on riparian habitats including the black-headed grosbeak, blue grosbeak, common yellowthroat, song sparrow, Swainson's thrush, warbling vireo, Wilson's warble, yellow-breasted chat, and yellow warbler.

Plan Actions

The National Park Service will develop guidance for management and conservation of biotic resources at the appropriate time. The National Park Service will identify and promote the conservation of all federally listed or proposed threatened or endangered species and their critical habitats within Park boundaries in ways that were consistent with the purposes of the Endangered Species Act. As necessary, the National Park Service will control visitor access to and use of critical habitats and might limit access to especially sensitive areas. Active management programs will be conducted as necessary to perpetuate the natural distribution and abundance of threatened or endangered species and the ecosystems on which they depend.

The National Park Service has prepared a list of all known federal, state, and locally listed threatened, endangered, rare, declining, sensitive, or candidate species that are native to and present in the Park, as well as their critical habitats. Controlling access to critical habitats or conducting active management programs will be considered that will be similar to activities conducted to perpetuate the natural distribution and abundance of federally listed species. Plant and animal species considered rare or unique to the Park will be identified and their distribution will be mapped. All management actions for protection and perpetuation of special status species will be determined through the Park's updated natural and cultural resource management plan or site-specific planning efforts.

Death Valley National Park will continue to manage and protect the 40-acre area known as Devils Hole, its endangered pupfish and other sensitive aquatic and terrestrial plants and animals. This area is within the external boundaries of Ash Meadows Wildlife Refuge managed by the U.S. Fish and Wildlife Service. NPS activities at Devils Hole include biannual pupfish counts, servicing of water monitoring equipment, and intermittent inventory/research activities. Each of these activities is designed to monitor the long-term status of the pupfish or its habitat.

Devils Hole pupfish counts will be conducted on a biannual basis. These counts will be scheduled for the spring and fall of each calendar year. The spring count is typically conducted in March or April, and the fall count is conducted in September or October. During a given census day, a morning and an afternoon count will be made at Devils Hole.

The water level monitoring program utilizes different types of equipment that store digital and hard copy formats of information. Operation and maintenance of the facility consists of bi-monthly inspections, monthly data retrieval, and periodic/annual maintenance. The bi-monthly inspections provide assurance of the correct equipment alignment with the staff gauges, data acquisition, equipment operation, equipment damage or misalignment resulting from seismic induced water level surges, and evidence of any vandalism to the site. Hydrologic field technicians also inspect, service, and replace equipment at Devils Hole three to five times per year.

Because Devils Hole possesses unique geologic and hydrologic characteristics, Park staff expect that a variety of research and/or inventory projects will be proposed at Devils Hole over the next several years. Many of these projects will be designed to provide baseline and research documentation of the hydrologic aspects and physical components of the pool. These studies may include but not be limited to measurements that involve dissolved oxygen content and distribution, existence and physical parameters of convection currents, water chemistry parameters, dimensions of the subterranean extent of the cavern, etc. Some of the proposed studies may also relate to biological components in the aquatic system.

Park staff have recently initiated a three year in-depth ecology study of the Devils Hole ecosystem. The study will provide a comprehensive inventory of the biological components that are present in the aquatic habitat (fish, invertebrates, and algae). The study will also describe the inter-related nature of the different species that are present, so a long-term monitoring and protection program for the entire biological community can be developed.

A site management plan has been prepared for the Eureka Dunes area. This plan, in consultation with the U.S. Fish and Wildlife Service, addresses the protection of sensitive species. Actions considered in this plan include moving both parking areas to less sensitive sites, a step-up plan for limiting human activities, if necessary, controlling actions on exotic Russian thistle, converting a hodgepodge of roads to foot access, and continuing the main access road in a graded, dirt condition. These will further enhance the protection of sensitive species as a result of being within Death Valley National Park.

Introduced Species

Background

Exotic species can include both plants and animals. They are generally defined as those species that occur in a given place as a result of direct or indirect, deliberate, or accidental actions by humans. Examples of exotic species in the Park include wildlife such as burros and chukar and plants like tamarisk and Russian thistle.

Plan Actions

Nonnative plants and animals will not be introduced except under the most unusual circumstances (i.e., historic landscape restoration at Scotty's Castle). The management of populations of exotic plant and animal species, up to and including eradication, will be undertaken wherever such species threaten Park resources or public health and when control is prudent and feasible.

Burros and Wild Horses

Background

From about 1920 to the 1960s, burro populations were kept at low levels by government agencies like the National Park Service and by the public. These efforts to reduce or eliminate feral burros from national park lands were park managers' response to the burros damaging park resources and changing the ecological composition at the expense of the park's native biotic communities.

In the 1950s the states of Arizona and California passed burro protection laws that limited the killing of these animals by private citizens. In the late 1960s, Grand Canyon National Park was prevented by public outcry from continuing the 40-year custom of shooting burros (NPS 1979). In 1971 the Federal Wild Free-Roaming Horse and Burro Act was passed. This act limited the killing of horses and burros on public lands administered by the Bureau of Land Management and the U.S. Forest Service. This law does not apply to NPS lands.

Before the passage of the California Desert Protection Act wild horse numbers were few to none within California desert national park units. Presently, the wild horse numbers within NPS units are low, about 10–20 animals. However, numbers are high in the four BLM herd management areas that are adjacent to Death Valley National Park. In these herd management areas, there are about 305 wild horses (BLM 1995b).

Before the passage of the California Desert Protection Act, the Bureau of Land Management managed 13 herd management areas in the California Desert District. Now the agency manages nine herd management areas, with four former herd management areas now within areas managed by the National Park Service. Of the Bureau of Land Management's remaining nine herd management areas, four are outside the Northern and Eastern Mojave planning area. The National Park Service agreed to manage new park lands to existing BLM authorized herd management levels until management plans were in place. These management levels are 334 burros and 9 wild horses for Death Valley. The existing burro population levels for the new lands added to Death Valley National Park greatly exceed the BLM herd management levels.

Nevada's BLM Las Vegas Field Office has two herd management areas adjacent to the Park, Amargosa and Ash Meadows herd management areas. Both are south of Amargosa Valley, Nevada, and both presently have zero animals and have management levels of zero animals. Other herd management areas within this resource area are at least 6 miles from the stateline. The Bureau of Land Managements policy is to remove all burros outside of their herd management areas.

Death Valley National Monument was established in 1933. In 1938 there were an estimated 1,500 burros in the monument, occurring in both the Panamint Range on the west and the Amargosa

Range on the east side of Death Valley. Burro reduction had started on a limited scale in 1939 and was carried on more extensively between 1958 and 1967. By 1967, 3,570 burros had been removed from the population: 1,790 by live trapping and removal, and 1,780 by direct reduction (shooting). In 1968, due to public sentiment, shooting was discontinued. Although all burros have been removed from the east side of the monument, by fall of 1970, there were an estimated 1,350 in the Panamint Range.

In 1973 the Park staff again began live trapping and shooting burros. About 400 burros were shot before discontinuing the practice in 1978.

Death Valley prepared an environmental impact statement in September 1977, which included 20 options for removal of burros. The Death Valley plan meshed with the interim management plans of the BLM's Bakersfield District, both of which supported NPS policies of removal of exotic species from units of the national park system. A cooperative agreement regarding burro management was drawn up among the Bureau of Land Management, the National Park Service, and China Lake Naval Weapons Center.

The approved plan was conducted in three phases:

> Phase one: Death Valley National Monument's capture and adoption — Remove all burros through live trapping over a three-year period, turning the burros over to animal protection groups to place in adoptions, live; and to construct 35 miles of fence in Nevada to exclude burros and cows. (In the Nevada triangle portion of the old monument cattle were as severe a problem as were burros).
>
> Phase two: animal protection groups remove stragglers over a one-year period.
>
> Phase three: zero population — go to direct reduction — shooting any remaining burros, to approach a zero population.

An agreement to conduct the roundups was made with the Bureau of Land Management and with the animal protection groups. The agreement was signed on July 2, 1982. The three-year roundup began in October 1983. Phase one ended in April 1986, removing alive nearly 6,000 burros. (The 1981 census was 2,501 burros). The government's cost was $1.7 million. Animal protection groups agreed to take all burros captured out for adoption, but took only 60%.

During phase two from fall 1986 to winter of 1987, 230 burros were removed by animal protection groups. Phase three began on July 1, 1987 and will continue as long as necessary within the old monument boundary.

On February 28, 1995, the Superintendent of Death Valley National Park agreed to an interim management policy for burros on lands formerly managed by the Bureau of Land Management (BLM) to maintain the BLM-approved management levels until a final decision was derived through the formal planning process. That level was 297 burros and 9 wild horses for Death Valley National Park.

The National Park Service estimates that at least 110 burros per year from Death Valley National Park need to be removed to reach the BLM-approved management levels. Under this interim policy all wild horses and burros removed will be captured and made available for adoption to the public.

In Death Valley National Park the estimated total wild horse and burro populations were about a dozen horses and 575 burros (December 1997 NPS data). The Park's Nevada triangle boundary and its southern boundary near Owlshead Mountains are its only areas where there is no adjacent BLM herd management area.

Death Valley National Park is still managing burros within its former monument boundary under a management strategy developed when it was a national monument. In 1995, a volunteer burro protection group began removing burros via live capture in lieu of the Park's removal policy. The Park has not abandoned its existing plans for burro removal within the old monument boundary, but has suspended its own removal plans while the volunteer group's efforts are underway. This group has removed about 20–30 burros per year. This volun-

teer operation has been at minimal cost to the federal government; however, it is questionable whether this removal level is helping to reduce the numbers toward zero.

Since many of the herd management areas are adjacent to National Park Service (NPS) lands, this plan will consider options, developed with Bureau of Land Management (BLM) and National Park Service interagency cooperation for wild horse and burro management within both NPS units and BLM lands.

The National Park Service initiated an aggressive removal program in 1999. Approximately 200 burros were rounded up using a combination of a volunteer group and BLM contract wranglers and helicopter. Approximately 190 additional burros were rounded up in 2000 by the same methods as 1999. It is estimated that about 300–350 burros remain in the Park.

Plan Actions

The National Park Service will adopt the "no burro or wild horse" strategy that exists for the former monument lands (NPS 1983) and will apply it to the newly added Park lands. Wild horses and burros, if encountered, will also be removed following the strategy described below. This plan updates the existing burro management component of the Park's *Natural and Cultural Resource Management Plan*. A cooperative agreement will be developed that assures that the Bureau of Land Management will take steps to control herds adjacent to the Park and will remove trespass burros and wild horses. The Bureau of Land Management has agreed to install boundary fences at critical points where herds are proposed adjacent to the Park, after consultation with the Park (Tim Salt, BLM District Manager, personal communication, 1998).

Removal of horses and burros from Park lands will be completed through a three phase removal program. Phase one consists of a Park-wide live capture program that will be in effect for a maximum of five years. Capture techniques during phase one will include three primary methods: 1) enticing burros and wild horses into corrals with water or food, 2) herding into corrals by using wranglers and possibly helicopters, and 3) netting and removal of burros with helicopters. This option will not be considered until corralling and herding methods become ineffective and remote terrain and cost-effectiveness become a consideration. All captured burros and wild horses will be adopted through existing BLM facilities or through direct or indirect adoption programs of the National Park Service, or adoption by the efforts of a third party. This phase began in 1999, and resulted in the live capture of 204 burros that were transferred to the Bureau of Land Management or a private burro advocacy group.

In phase two the National Park Service will actively solicit interested animal protection groups that will begin removing the remaining few animals. An agreement will be signed with the group(s) to provide up to 2 years to remove the remaining burros and wild horses from the Park at their expense. The National Park Service will provide oversight, and possibly some logistics support and use of some equipment and corrals. The duration of the phase two approach will be determined by effectiveness of the protection group capture efforts, i.e. if the groups could not demonstrate that they were capturing animals at a rate that was faster than the animal's reproductive rate, the time frame for phase two will be shorter than two years. It is anticipated that most of the burros and wild horses in the Park will likely be captured and removed through phases one and two. If no interested group is found within six months after the completion of phase one, the National Park Service will begin phase three.

In phase three NPS staff will eliminate the remaining few animals in the most cost-effective and humane manner to achieve a zero population. Removal efforts could involve a variety of techniques including, but not limited to shooting, wrangler/helicopter roundups, and netting-removal with helicopters. Phase three will continue for an indefinite time. Phase three could be suspended and phase two reinitiated if an animal protection group comes forward to conduct capture activities and provides clear evidence that their efforts are able to maintain herd levels at near zero levels. The Park will work expeditiously with groups that can demonstrate an effective ability to capture.

Phases can be run concurrently in different parts of the Park. For instance, the old monument lands have been in phase three for several years. This phase has been temporarily suspended while animal protection groups are actively working to capture burros there. The Park also maintains the option of returning to phase three in the old monument lands if live captures do not succeed in reducing the populations. As captures in the new Park lands proceed, a particular area of the Park, such as Saline Valley, could be placed in phase two or phase three separate from the rest of the Park.

The Park Service is aware of the burro's potential for rapid population growth (up to 20% per year). The above proposed removal strategy will result in a burro and wild horse population that approaches zero.

Concurrently with these control actions, when funding is made available, the National Park Service will work with the Bureau of Land Management and the California Department of Fish and Game on feasibility studies that involve boundary fences that are similar to the fence that has existed around the Nevada Triangle since 1988.

Other Nonnative Animals

Aquatics. Death Valley National Park has a number of aquatic exotic species. Mosquito fish, goldfish, crayfish, and bullfrogs are common in the Saline Valley. Mosquito fish are also found at Furnace Creek. The aquatic exotic species listed have all been documented to result in adverse impacts to native aquatic fauna (CDF&G 1/12/99 letter to NPS). Wherever and whenever possible these exotics will be controlled to a level eliminating their adverse impacts, or they will be extirpated altogether from Park habitats.

Chukar. The chukar (*Alectoris chukar*), an upland game bird, popular among hunters, was first introduced into California (from India) in 1932 (Mallette c. 1970). Between 1932 and 1955, over 52,000 birds were released by the California Department of Fish and Game (Mallette c. 1970). The birds prefer rocky open hills and flats. Sightings have been reported from below sea level to above 12,000 feet in the White Mountains and Sierra Nevada. Chukar are abundant in every valley and mountain range in Death Valley National Park.

Tamarisk

Background
The tamarisk (*Tamarix ramosissima*), or salt cedar, an introduced shrub or small tree, 5 to 20 feet tall, is an opportunistic invader of moist areas. There are many areas in the Park where this plant has choked out native vegetation. Both the Bureau of Land Management and the National Park Service have ongoing control programs that are attempting to manage this invasive plant. Continuing control is needed to prevent this weedy tree from outcompeting and eliminating native vegetation. A larger relative, the athel (*T. Aphylla*), has been planted, typically as a windbreak or sand-break, in a number of locations in the Park (e.g. near Furnace Creek, Death Valley Junction, and Shoshone). Although not as invasive as tamarisk, the athel is also believed to be an invader of native habitats. Death Valley National Park is reducing the potential for reintroduction by encouraging the use of other types of shade trees, landscaping, and windbreak plantings in developed areas within and outside the Park.

Plan Actions
The Park will continue to actively pursue the removal of nonnative tamarisk. Tamarisk eradication efforts will continue to identify areas where *Tamarix ramosissima* was gaining a foothold.

Other Nonnative Plants

Russian thistle (commonly called tumbleweed) is common in many disturbed portions of the Park, including the Eureka Dunes area, approximately 300 acres near Harrisburg Flats at Skidoo, other old mining sites, and along roadsides.

Date and Washington palms have become established at several backcountry springs in Death Valley National Park. These palms may be removed if it is determined that they are not part of the historical scene.

Introduced annual grasses, such as *Bromus* and *Schismus* species, are serious pests when mature (Hitchcock and Chase 1971). "The narrow, sharp-pointed minutely barbed florets (or fruits) with their long rough awns work into the eyes, nostrils, and mouths of stock, causing inflammation and offer serious injury" (Hitchcock and Chase 1971). The increase of these grasses throughout much of the arid west is believed to be an important contributing factor in the increase in desert wildfires, which used to be uncommon.

Hornwort, an aquatic annual plant with dense growth, is being removed from Saratoga Spring near the southeast boundary of the Park (NPS 1988).

Plan Actions
The Park will continue the limited programs to control Russian thistle and hornwort (an aquatic annual plant at Saratoga Springs). However, as resource monitoring efforts highlight other problems, or research provides solutions to known problems, funding will be sought for additional eradication programs.

Disturbed Land Restoration

Background
Disturbance of the native vegetation and soils in the Park has occurred as a result of many human activi-

ties, including mining, road building, utility lines, dumps, grazing, burros, offroad vehicles, and fire. No comprehensive inventory of this disturbance has been completed to document the areas, period of disturbance and extent of recovery.

Plan Actions

The National Park Service will seek to perpetuate native plant life as part of natural ecosystems. Natural landscapes and plants will be manipulated only when necessary to achieve approved management objectives. To the maximum extent possible, plantings in all areas will consist of species native to the Park or historically appropriate for the period or event commemorated. Native species will be emphasized. The use of exotic species will conform to the NPS exotic species policy (NPS 1988). Landscapes and plants might be manipulated to maintain habitat for threatened or endangered species, but in natural areas, only native plants could be used if additional plantings were done. Existing plants will be manipulated in a manner designed to restore or enhance the functioning of the plant and animal community of which the endangered species is a natural part.

In natural areas landscape conditions caused by natural phenomena such as landslides, earthquakes, floods, and natural fires will not be modified unless required for public safety, protection of NPS facilities, or necessary reconstruction of dispersed-use facilities, such as trails. Terrain and plants could be manipulated where necessary to restore natural conditions on lands altered by human activity.

In cultural areas, such as at Scotty's Castle, trees, other plants, and landscape features will be managed to reflect the historic landscape or the historic scene associated with a significant historic theme or activity.

Death Valley National Park will continue rehabilitating abandoned mine sites. Rehabilitation efforts will continue to use techniques such as netting shafts and gating adits to eliminate safety hazards. Each site will be individually evaluated and action taken as appropriate to restore the area to as a natural conditional as possible, while considering other cultural and natural values. Consideration of bats and other wildlife, as well as cultural resources will be an integral part of the decision process.

FIRE MANAGEMENT

Background

Although the National Park Service recognizes the natural role of fire in ecosystem processes, the effects of fire on components of desert ecosystems are not well understood. The National Park Service is assessing and documenting the state of existing fire effects research in desert ecosystems and formulating a desert fire management strategy. Unit-specific fire management plans will be developed consistent with this policy. Over the short term (1–10 years) the fire management policy will be guided by the best available scientific knowledge of fire effects and by current NPS policy direction. A number of changes will be implemented with regard to agency-wide fire management policy.

The effects of fire on components of desert ecosystems, and the extent and degree of its historic role on biota are not well understood. The National Park Service is assessing and documenting the state of existing fire effects research in desert ecosystems. Over the short term (1–10 years) fire management strategies will be developed based on the best available science, field observations of fire effects and post-burn monitoring of selected sites. In cooperation with other desert parks, other federal and state land managers, and the research staff in the agency or at universities, fire-related research needs will be identified and long-term studies initiated. Specific research topics might include postfire successional trends, or effective postfire rehabilitation strategies.

Plan Actions

Management options include full suppression, prescribed fire, natural fire managed to achieve benefits to natural resources, or a combination of these. In many cases, appropriate management strategies will be pre-determined in the planning process, based on life and property considerations, location, identification of natural or cultural resources at risk, existing vegetation and fuels, terrain, and other factors. In other instances, management strategies will be determined on an individual basis, factoring in additional variables such as current and predicted weather conditions, staffing levels, resource management objectives, terrain, and identified planning parameters. Research burns might be initiated within specific prescriptions, and burn sites will be monitored to assess changes over time.

Protection of life and property is first and foremost. All human caused wildfires will be suppressed, and all fire management actions will be implemented using methods, equipment and tactics which cause the least impact to natural resources. Heavy equipment, such as bulldozers, will not be used except in emergencies as determined by the Superintendent. All staff will receive training on appropriate strategy, tactics and precautions in sensitive species habitat.

Fire management strategies within wilderness areas will also be determined based on the criteria discussed above. Additionally, a "minimum requirement" process will be undertaken for every fire in wilderness to determine the "minimum tool or administrative practice necessary to successfully and safely accomplish the management objective with the least adverse impact on wilderness character and resources" (NPS *Management Policies*). The use of mechanized equipment and transport (i.e. chain saws, portable pumps, vehicles and aircraft) will remain an exception to be exercised sparingly and only when it meets the test of being the minimum necessary for wilderness purposes or the protection of life or property. Such exceptions must be approved by the Superintendent or his/her designee.

Based on the results of fire management research, the Park will periodically revise its "Fire Management Plan."

RESEARCH

Background

Research and education are core mission elements of the NPS national goals and of the Park's enabling legislation. Congress highlighted these issues in the CDPA with following passages:

> These desert wildlands display unique scenic, historical, archeological, environmental, ecological, wildlife, cultural, **scientific, educational** and recreational values used and enjoyed by millions of Americans for hiking and camping, **scientific study** and scenic appreciation. (emphasis added)
>
> Retain and enhance opportunities for scientific research in undisturbed ecosystems.

Plan Actions

High quality information is vital for the proper management of the Park and protection of Park resources. The Park uses a multi-faceted process to initiate the accumulation of scientific knowledge. Studies may be conducted with in-house expertise and funding, or with outside assistance (both money and people).

Park resource information needs are defined within the Park's *Natural and Cultural Resources Management Plan*. The *Natural and Cultural Resources Management Plan* is a document that lists Park research needs, threats to Park resources, projects that would mitigate the threats, and a ranking of these projects. Each year these lists are submitted for national ranking and possible funding. The *Natural and Cultural Resources Management Plan* is updated as needed to maintain a current listing of issues and threats. Funding for projects may be from the existing Park budget, receipt of funds from system-wide competition, or outside funding sources, such as grants.

Independent researchers often apply to the Park for research permits. Such research is encouraged. The information gained may have practical application for the protection of Park resources or for visitor enjoyment. More theoretical research may, in the long run, yield the basic knowledge necessary to protect Park resources. Information may be valuable to the field of science far beyond Park boundaries. Independent research supports the concept of "parks as classrooms" when students learn from the protected natural resources of the Park. The Park functions as a natural laboratory open for observation and scientific inquiry. The Park, through scientific research, provides information to outside areas about desert ecosystems, and provides the baseline by which the uses of those areas may be evaluated.

Research permits or scientific collection permits are issued to researchers from universities, museums or other agencies when their studies are consistent with legislation, especially the NPS Organic Act of 1916, the California Desert Protection Act of 1994, the Wilderness Act of 1964, and the National Parks Omnibus Management Act of 1998. Some research projects propose techniques that unacceptably impact Park resources. Preference is given to projects which have a high benefit to Park resource protection, visitor enjoyment or science, and a low impact on Park resources.

Congress reinforced the research objective of Death Valley in the California Desert Protection Act, and again in the 1998 National Parks Omnibus Management Act. Title II of that act contains the following:

- A mandate for research;
- Authority to enter into cooperative agreements with colleges and universities for the purpose of conducting multi-disciplinary research;
- Establishment of baseline information enabling the monitoring of long-term trends in the condition of national park system resources.
- An invitation for scientist to conduct approved research within units of the national park system.
- Measures to assure Park managers use research results in Park management.

Scientific research is not new to the Park. The Park will continue to procure the best science to meet its resource protection and management requirements.

Inventorying and Monitoring

Background

Inventorying and monitoring the Park's natural resources are necessary to gain a more complete understanding of their value and condition.

Plan Actions

The National Park Service will develop and implement a systematic, integrated program to identify, inventory, and monitor the Park's natural resources. The Park will work with academic institutions in retaining and enhancing opportunities for scientific research in undisturbed ecosystems such as the Park's wilderness areas. The Park will consult with people with expertise in the resource or in developing and implementing an inventorying and monitoring program. A comprehensive strategy will be developed and implemented to ensure that regional, local, or national trends are documented and appropriate actions undertaken.

The Park's existing *Natural and Cultural Resources Management Plan* will be updated to reflect the changes that are proposed in this *General Management Plan* for Death Valley National Park. The updated plan will present a detailed program for managing the Park's natural and cultural resources.